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OCEANOGRAPHIC ANALYSES AND FORECASTS FOR FLEET SUPPORT (SERVICE--ETC(U)
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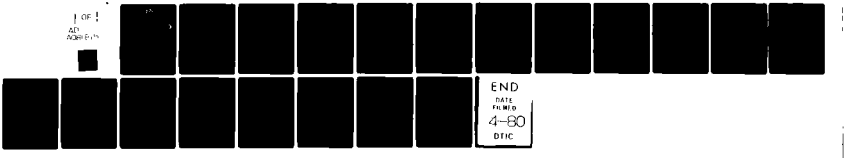


OCEANOGRAPHIC ANALYSES AND FORECASTS FOR FLEET SUPPORT (Services and Codes)

Fleet Numerical Weather Facility
Monterey, California

Technical Memo. No. 11-2
Revised Aug 67

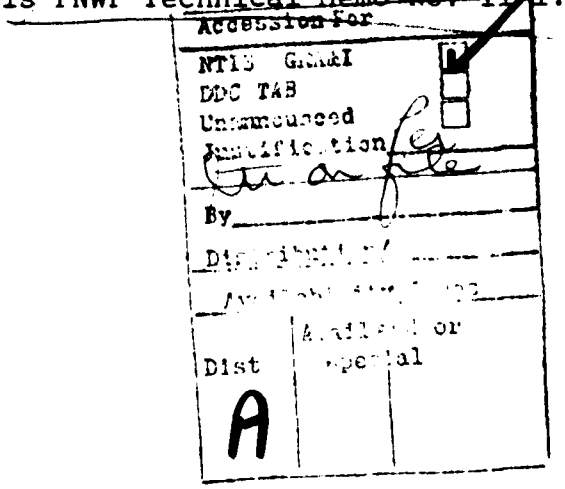
Contents

INTRODUCTION

The Fleet Numerical Weather Facility provides timely, hemisphere-wide oceanographic products in support of the Operating Forces of the U. S. Navy. These products are issued on an operational basis in the form of oceanographic analyses and forecasts.

This memorandum describes the type and availability of FNWF oceanographic services and their corresponding codes. The codes presented in this memorandum are those of the type which are in general use, however codes can be used which are mutually agreed upon by the users. A series of manuals and textbooks describe both numerical and subjective methods or use in oceanographic support problems.

The Fleet Numerical Weather Facility at Monterey appreciates comment, criticism and suggestions from all units in the belief that these lead to improvement of the environmental support. Periodic revisions of this memorandum will occur as additional progress is made in the field of synoptic oceanography. This memorandum cancels FNWF Technical Memo No. 11-1.



REQUEST FOR SERVICES AND TRANSMISSION OF DATA

FNWF oceanographic services are divided into two categories

a. Those which are disseminated on a routine basis to the operating forces and

b. Those which are intermittently requested for specific areas, times and occasions.

Request for Services

Requests for specific services and forecasts, see Table I, should be directed to the appropriate Fleet Weather Central or to Fleet Numerical Weather Facility at Monterey. Requests for new programs or extensive changes in the existing routine services should be addressed to the Commander, Naval Weather Service Command.

Dissemination of FNWF Products

The numerical oceanographic analyses/forecasts prepared at Monterey are disseminated via high-speed computer data links to the Fleet Weather Centrals. The weather centrals in turn plot the data on their local area charts, making subjective changes that are dictated by peculiar local conditions, and then retransmit the data either in a message or facsimile form. Transmission times and frequencies are established and promulgated by the fleet commanders.

1. WAVE ANALYSES/FORECASTS

Sea and swell wave analyses and forecasts which can be extended to 48 hours upon request, are computed twice daily with base times of 00Z and 12Z. They are transmitted to various Fleet Weather Centrals for broadcasting in either facsimile or message form. The analysis consists of computed heights, periods and direction, as a function of wind speed, fetch and duration, modified by wave observations from ships.

Upon request, standard message programs can extract from the analysis or forecasts for any given latitude and longitude intersection either the significant wave height, period and direction or the predominant swell height, period and direction. However, care should be exercised in the use of these parameters in areas where there are significant local effects caused by terrain. Wave heights are also included in the SOCAL, NFK and HPS exercise area forecasts, see 5.1.

2. THERMAL STRUCTURE ANALYSES/FORECASTS

Thermal structure analyses and forecasts are descriptions of the water mass types at specific latitude and longitude intersections, in either a chart or temperature-depth profile form. They are transmitted via addressed message or over assigned multipurpose braodcasts, in either a code format or facsimile presentation.

2.1 Sea Surface Temperature

Sea surface temperature analyses for the northern hemisphere are prepared twice daily at 00Z and 12Z. There are presently in preparation various SST prognosis programs.

However, an analysis is sufficient to support most short range naval operations. Forecasts of this element can be expected to show a standard deviation of 0.7°F.

2.2 Mixed Layer Depth, Sonic Layer Depth, Thermocline Magnitude and Gradient

The mixed layer depth, MLD, is defined by FNWF as the 24 hour average depth of the lower boundary of the turbulent, mixed surface layer or the upper boundary of the thermocline. In the absence of any sharp inflection point, the MLD can be defined as the depth where the temperature is 2°F colder than the SST. Thus, under some conditions in which a well defined thermocline might not exist, the potential depth of the thermocline can still be defined. The MLD is analyzed twice daily and a 24 hour forecast is made.

The MLD might or might not coincide with the sonic layer depth, SLD is defined as the depth of maximum sound velocity in the surface layers. In areas where the density of BT observations permits a determination of the upper sound speed maximum, the SLD replaces the MLD on FNWF analyses. The differences between the two have diminished in importance as complete sound speed profiles are now being provided by FNWF.

Analyses of the thermocline gradient and the depth to the bottom of the thermocline are available twice daily upon request.

2.3 Transient Thermoclines

Transient thermoclines, the "afternoon effect" resulting in an upper sound channel, are computed twice daily at 00Z and 12Z. Their depth, intensity and the probability of overnight persistence is incorporated into the charts and messages. Transient thermoclines are most common during the spring and summer.

2.4 Temperatures at standard depths

Hemispheric analyses of surface and subsurface temperatures are computed twice daily for the following levels: 0, 100, 200, 300, 400, 500, 600, 800 and 1200 feet. These are routinely transmitted to the various weather centrals in chart form and are available upon request.

2.5 Small-Scale Analyses/Forecast (Zoom Programs)

Detailed oceanographic analyses and forecasts are made twice daily for three Navy exercise areas, SOCAL, GLFM, NFK, and the HPS, on a small-scale grid (about 25 miles at present). Similar analyses, such as special zoom programs for unusual current boundary areas -- an example of which is the SST and current analyses provided the U. S. Coast Guard in the International Ice Patrol area, can be made for any ocean area for any scale which is justified by the three-dimensional variability, the data density and users requirement. However, in many ocean areas the smallest meaningful grid size is about 100 miles.

3. TEMPERATURE AND SOUND SPEED PROFILES

3.1 Temperature-depth/Sound speed profiles

Twice daily, at selected ocean locations, temperature-depth extractions are made. These vertical profiles are utilized, with an average salinity of 35°/oo for the present in the computation of the BT/SV forecasts. This data is transmitted to the various users in either a message or graphical chart form. Amplifying information such as (a) depth of transients, probability of their occurrence, magnitude and probability of persistence and (b) the depth of the thermocline, its tendency and range of short-term fluctions, is also included.

3.2 Sound propagation forecasts

This data is now operationally available on a requested basis for any Northern hemisphere ocean location. Detailed descriptions and applications are covered in FNWF Technical Notes 17, 18, and 30 of 1967. Examples of this data are:

a. depth excess of convergence zone propagation
b. range to the convergence zone
c. propagation loss for a number of frequencies
d. ray tracing for significant rays
e. best depth for variable depth sonar.

However, when requesting this service the type of sonar equipment should be specified.

4. OTHER OCEANOGRAPHIC SERVICES AND PRODUCTS

4.1 Upon request, outlooks of oceanographic and sonar conditions in specified areas can be prepared for planning purposes. These outlooks are computed from hydrocline information in a condensed form placing special emplasis on local conditions which might significantly affect a given operation

4.2 Currents, current boundaries

Surface current analyses and 24-hour forecasts are computed twice daily, and this information is available upon request. The computations give current transport in nautical miles per 24 hours and the current directions. The locations of the boundaries of major currents (boundaries of water mass types and oceanographic regimes) can be computed twice daily and are thus available upon request.

4.3 Other oceanographic programs

The following oceanographic analyses are available or are being developed*:

*a. Light penetration and visibility in the ocean.

*b. Oceanic tides (ranges, cotidal times) and internal tides.

c. Anomalies of oceanographic parameters, e.g., Sea Surface Temperature, Mixed Layer Depth, Heat Exchange, etc.

*d. Analyses/Forecast for amphibious and other coastal operations.

*e. Bottom sediment types and their sonic properties (partially completed).

Comments and requirements for these programs are invited, especially those under development.

5. CODES

Codes are divided into two groups -- those in general use and those agreed upon between the particular users and weather facilities. This section deals only with the first group of codes.

5.1 Message format

Data can be extracted at given latitude and longitude points for desired parameters; messages can then be prepared for transmission via high-speed computer link or conventional teletype.

Sample Forecast Mixed Layer Depth Message:

Catalog number → B40Q 24

	24	12Z 22 SEP 65		POTMLD	LAYER	DEPTH	FEET	
N	180	179W	178W	177W	176W	175W	174W	173W
55	00289	00355	00286	00021	00089	00239	00301	00238
54	00220	00330	00356	00311	00365	00370	00310	00201
53	00193	00316	00361	00342	00326	00268	00198	00133
52	00157	00226	00225	00197	00172	00151	00135	00101
51	00135	00177	00158	00136	00132	00124	00124	00111
50	00138	00186	00159	00158	00195	00170	00153	00141
49	00146	00169	00168	00180	00177	00184	00183	00191
48	00186	00192	00198	00200	00211	00222	00218	00211
47	00248	00243	00237	00215	00235	00189	00196	00151
46	00306	00315	00299	00275	00263	00240	00215	00181

Examples:

53.0N
179.0W — Mixed Layer Depth 316 feet

49.0N
176.0W — Mixed Layer Depth 177 feet

For the Navy exercise areas off Norfolk, Southern California, Gulf of Mexico & Hawaii, sea environmental forecasts are prepared twice daily. An example of such a forecast is given below:

VCAP N	SEA 75.0	24 HR PROG 74.5	74.0	FROM 73.5	00Z 73.0	19 FEB 72.5	66 SEA ENVIRON 72.0	71.5	71.0	70.5	70.(
420										20335	3203
415									32136	33436	3343
410							31838	33337	33537	33337	3333
405						33541	33540	33439	33438	33339	3333
400				23943	23743	33543	33442	33442	33442	33342	3334
395		21045	23844	23544	33544	33543	33444	33444	33444	33345	3334
390	20845	22744	23743	33544	33544	33544	33444	33545	33446	33447	3334
385	21846	23844	33544	33544	33444	33443	33445	33347	33348	33250	3325
380	22646	33646	33446	33346	33346	33345	33347	33249	33251	33253	3315
375	33647	33346	33247	33249	33250	33251	33152	33153	33154	33055	3305
370	33148	33147	33150	33053	33055	33056	32956	32956	32956	32958	3296
365	33053	32952	32955	32857	32859	32860	32860	32860	32860	32861	3276

The first vertical column gives N latitude for every half degree and the second horizontal line gives W longitude for every half degree. At the intersection of corresponding latitudes-longitudes the five figure group gives sea height (in code), mixed layer depth in tens of feet and sea surface temperature in °F.

Example: 39.0N 074.5PW

22744

2 - sea height code (WMO 75), wave height 1/3 to 1-2/3 feet

27 - mixed layer depth 270 feet

44 - sea surface temperature 44°F

5.2 Temperature-depth profile codes

The profile codes are computed in either a classified or unclassified form. When the position of the profile is classified, as agreed upon by the user and FNWF, a geographical indicator and a number will be transmitted. However, the text portion of the code form is identical.

HEADING: PAC/LANT 36 HR BT/SV FCST FROM 12Z 15 JUN 67

$XQL_aL_aL_a$ $L_oL_oL_oY_1Y_2$ OOTTT Z_1Z_1TTT Z_2Z_2TTT...et

$TZ_gZ_gP_1T_1$ $PP_2M_dZ_gZ_g$ $GT_gT_gZ_gZ_g$

$XQL_aL_aL_a$

X	Beginning of message; can be a bilateral special code (e.g. X - English units; Y - metric units)
Q	Octant of the globe
$L_aL_aL_a$	Latitude in full and tenth of degree
$L_oL_oL_oY_1Y_2$	
$L_oL_oL_o$	Longitude in full and tenth of degree
Y_1Y_2	Filler; can be used to provide bilateral special codes (e.g. Y_1 = K - profile does not reach 1000 feet; Y_2= L, profile deeper than 1000 feet.

When the position is classified the group "GINN" will proceed the text.

GI Geographical Indicator
PO = Pacific Ocean
AO = Atlantic Ocean,
MS = Mediterranean Sea
NS = Norwegian Sea, etc.
NN Numerical designator of the position.

00TTT

00	Surface identifier
TTT	Surface temperature in °F and tenths

Z_1Z_1TTT

Z_1Z_1	Average depth of the top of thermocline in tens of feet
TTT	Temperature at the top (upper boundary) of the thermocline °F and tenths

Z_2Z_2TTT

Z_2Z_2	Depth (at hundred foot intervals 04 = 400; 12 = 1200)
$TZ_gZ_gP_1T_1$	This is an optional group for transients. This might be omitted or repeated if several transient thermoclines are expected. No more than two will be forecasted.
T	Identifier for transient thermoclines.
Z_gZ_g	Depth of the transient thermoclines in feet.

- -

Code for reporting sea conditions

(WMO 75)

Code Figure		Height	
		meters	feet
0	Calm-glassy	0	0
1	Calm-rippled	0 - 0.1	0 1 1/3
2	Smooth-wavelets	0.1 - 0.5	1/3 - 1 2/3
3	Slight	0.5 - 1.25	1 2/3 - 4
4	Moderate	1.25 - 2.5	4 - 8
5	Rough	2.5 - 4	8 - 13
6	Very rough	4 - 6	13 - 20
7	High	6 - 9	20 - 30
8	Very high	9 - 14	30 - 45
9	Phenomenal	over 14	over 45

P_1 Probability of occurrence of the transient thermoclines (diurnal thermoclines or "afternoon effects") in tens of percent (i.e. 0 - 9 = 0, 10 - 19=1, 20 - 29 = 2, etc.)

T_1 Code for the magnitude of the transient thermoclines and/or the temperature difference between the sea surface and top of the thermocline

Code Number	Temperature difference in °F
0	< 0.3°F
3	>0.3° ≤0.6°F
6	>0.6° ≤0.9°F
9	>0.9°F

$PP_2M_dZ_2Z_2$ Optional Group

P Identifier

P_2 Probability of the persistence of the transient thermocline throughout the night and into the next day in tens of percent (i.e. 0 to 9 = 0, 10 to 19 = 1, 20 to 29 = 2, etc.)

M_d Code of the expected tendency of the change of average depth of the thermocline and the nature of the thermocline.

Code Number	Tendency criteria and thermocline nature description
1	Large fall > - 15 feet
2	Small fall -5 to -15 feet
3	Small or no change -5 to +5 feet
4	Small rise +5 to +15 feet
5	Large rise > + 15 feet
10	

Code Number	Tendency criteria and thermocline nature description
6	Deep thermocline, near-homothermal structure at medium and high latitudes
7	Thermocline gradient small, thermocline not well develope and its depth difficult to ascertain
8	Large fluctuations of MLD

Z_gZ_g Magnitude of short-term fluctuations of the depth of the main thermocline in feet (caused by internal waves and other factors

(Standard deviation)

Note: The facsimile chart contains a crossing bar on the temperature-depth trace with an identifying letter T and with the code numbers of probability of occurrence (P_1), probability of persistence (P_2) and gradient (T_1). The average depth of the thermocli is likewise identified with a crossing bar, identifying letter P and code number for thermocline nature and tendency (M_d) and the $\pm$ fluctuation range will be printed out.

$GT_gT_gZ_gZ_g$ Optional group, but will be present in most computerized thermal profile forecast

G Group identifier

T_gT_g Temperature gradient °F/100 feet in the thermocline, in full and tenth of °F

Z_gZ_g Bottom of the thermocline in tens of feet (If the profile exceeds 1000 feet, the unit of thousands is omitted.)

SOUND VELOCITY PROFILE

The SVP message form will normally follow the TD profile to which it pertains in the following code form, with the position omitted:

SVP XY_1S_8 or (S_9) 00VVV TZ_LVVV BZ_2VVV

Z_3Z_3VVV ZZVVV ..... etc.

SVP XY_1S_1

X and Y_1 have the same meaning (units and depth) as above. S_1 indicates whether an actual (or climatological) salinity distribution has been used in sound velocity computation or a constant value has been taken (35%): S_1 = 8 - salinity has been taken constant 35%. S_1 = 9 - actual (or climatological salinities have been considered.

00VVV	
00	Surface identifier
VVV	Sound speed in feet per second, omitting the thousand digit (4 or 5)
TZ_1VVV	Optional group
T	Identifier, top of transient
Z_1	Top of transient in tens of feet
VVV	Sound speed at this depth
BZ_2VVV	Optional group
B	Identifier, bottom of transient
Z_2	Depth of the bottom of the transient
ZZVVV	Depth of the maximum sound speed and the actual speed (or sound speed at MLD)
ZZVVV	Depth and sound speed at 100 foot intervals as in BTP code above

Other codes for different sonar forecasts such as propagation loss forecasts are classified and will be provided upon request. The list of other oceanographic analyses/forecasts and their identifier are given in Table 1.

Synoptic oceanographic analyses/forecasts
available for fleet support

All base time 00Z/12Z

Product	Fcst Period	Chart	Msg	Ident	Cat#	Remarks
Waves						
Wave direction	12,24,36,48		X	WD	B01	Tens of degrees (from)
Wave period	12,24,36,48		X	WP	B02	Seconds/2
Wave height	12,24,36,48	X	X	WH	B03	Feet
Swell direction	12,24,36,48		X	SD	B04	Tens of degrees (from)
Swell period	12,24,36,48		X	SP	B05	Seconds/2
Swell height	12,24,36,48	X	X	SH	B06	Feet
Combined direction	12,24,36,48		X	CD	B07	Tens of degrees (from)
Combined period	12,24,36,48		X	CP	B08	Seconds/2
Combined height	12,24,36,48	X	X	CH	B09	Feet
Surface Currents						
Current transport	24	X	X	CURTRANS	B31	Nautical miles/day
Current stream function	24	X		CURRSTRM	B30	Non-dimensional stream function
Current boundaries		X		GG THETA	B35	
u component of current transport	24			U CURR	B32	
v component of current transport	24			V CURR	B33	
Current direction, transport and stream function for 2 zoom areas for U.S.C.G. Intl. Ice Patrol		X				

TABLE I

Product	Fcst Period	Chart	Msg	Ident	Cat #	Remarks
Ocean Outlook						
Exercise climatology (see 4.1)	**					
Temperature, salinity and sound speed from surface to bottom	***	X				
Thermal Structure						
Sea surface temperature		X	X	SEA TEMP	B10	Degrees & 10ths of °F or °C
Sea surface temperature Hawaiian Operating Area		X	X	HAWTS	B11	Degrees & 10ths of °F or °C
Sea surface temperature Norfolk Operating Area		X	X	NFKTS	B13	Degrees & 10ths of °F or °C
Sea surface temperature Southern California Area		X	X	SCTS	B12	Degrees & 10ths of °F or °C
Sea surface temperature in International Ice Patrol Areas (2)		X		CGA,B	B14	Degrees & loths pf °F or °C
Sea surface temperature Gulf of Mexico		X		GLFM	B14	Degrees & 10ths of °F or °C
Potential Mixed Layer Depth	24	X	X	POT MLD	B40	Tens of feet
Mixed layer depth Hawaiian Operating Area	24		X	LD HAW	B60	Tens of feet
Mixed layer depth Norfolk Operating Area	24		X	LD NFK	B62	Tens of feet
Mixed layer dapth Southern California Area	24		X	LDSC	B61	Tens of feet

**Prepared for specified time increments upon request.

***Profile extracts available at any specified Position

Product	Fcst Period	Chart	Msg	Ident	Cat#	Remarks
Thermocline Gradient	24	X	X	GT	P10	Degrees F/100 feet
Thermocline gradient Hawaiian Operating Area	24*	(X)		GTHAW	P11	Degrees F/100 feet
Thermocline gradient Norfolk Operating Area	24*	(X)		GTNFK	P12	Degrees F/100 feet
Thermocline gradient Southern California Area	24*	(X)		GTSCL	P13	Degrees F/100 feet
Magnitude of Thermocline	*	(X)	X	MT	P20	
Magnitude of thermocline Hawaiian Operating Area	*	(X)		MTHAW	P21	
Magnitude of thermocline Norfolk Operating Area	*	(X)		MTNFK	P22	
Magnitude of thermocline Southern California Area	*	(X)		MTSCL	P23	
Probability of Occurrence of Transients		X	X	P OCC	B42	Percent
Gradient of Transients	**		X	TR	P30	Degrees and 10th °F
Thermocline Tendency	**		X	TT	P31	Code
Thermocline Fluctuations	**		X	FT	P32	Feet
Temperature at Standard Levels (100, 200, 300, 400, 600, 800, 1200 feet)	**		X	TS--()		Degrees and 10ths F° Catalog numbers assigned for each level - see catalog.

* Prepared upon request.

** In BT/SV messages (fields available upon request

Product	Fcst Period	Chart	Msg	Ident	Cat#	Remarks
Latent and Sensible Heat Exchange		X	X	Q---HE	B70	g cal $cm^{-2}(24)^{-}$;
Total Heat Exchange		X	X	Q---N	B71	g cal $cm^{-2}(24h)^{-1}$
Sound Propagation						
Sound Velocity Profiles	24**	X	X	SOUNDVEL	B50	Feet/second
Bathythermograph Profile	24**	X	X	BT FCST	B51	°F vs. depth
Propagation Loss	*	(X)	X	S-L	P53	80 and 85 db distance
Range to convergence zone	*	X	X	R-Z	P54	Nautical miles or kyds
Depth Excess for convergence zone	*	(X)				
Propagation Ray tracing	*	(X)				
Sediment type	*	(X)				
Sea Temp Small-Scale Disturbance		X		SD SEA	B15	
Sea Temp Residual Field Pattern		X		SR SEA	B16	
Sea Temp Large-Scale Disturbance		X		SL SEA	B17	
Sea Temp Anomalies from Long Term Mean Value (5, 15 and 30 day anomalies		X		TA	B18	

* Prepared upon special request

** In BT/SV message